Fact Sheet

Swine Breeding and Genetics

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# Boar Selection Guidelines for Commercial Producers

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## Introduction

The performance level of the commercial swine herd is determined by two things. These are genetics and the environment. The contributions by genetics are the result of superior performance of the boars and gilts you select and the crossbreeding program you use. The contribution of the environment, that is, your husbandry and management practices, will then allow or hinder the expression of the genetics potential for performance in the offspring of selected boars and gilts. The purpose of this publication is to provide recommended guidelines for the selection of replacement boars.

## Traits to Consider When Selecting Boars

Traits usually considered may be grouped into general categories of: (1) behavioral, (2) sow productivity, (3) feedlot performance, (4) carcass merit, (5) soundness, and (6) conformation-type.

## Behavioral and Sow Productivity

Behavioral traits include: docility, temperament, and the complex of traits associated with reproductive potential (sexual—development, maturity, and aggressiveness). Sow productivity traits include: reproductive ability, litter size, milking ability, and mothering ability. Number of pigs farrowed and weaned, and individual pig and litter birth weights are the most common measures. Litter weight at 21 days/sow exposed to boars is probably the best single measure of sow productivity. Behavioral and sow productivity traits tend to have low to average heritability levels. These traits are also those which tend to show above average heterosis responses with crossbreeding. They have above average economic values. Thus, when selecting boars for these traits use the records of sire and dam, litter records, records of other relatives, and any records available on the boar being selected. Also, use a crossbreeding program to maximize heterosis for these traits.

## Feedlot Performance

Feedlot performance traits include growth rate—measured as: gain/day from weaning to market, gain/day from 60 to 230 lb., or age at 230 lb.; and feed conversion (lb. feed/lb. gain). These traits tend to have average heritability levels (20-50%) and show average heterosis responses (5-15%) with crossbreeding. These traits are above average in economic value. When selecting for these traits place more emphasis on the boar's own record and less emphasis on records of relatives.

## Carcass Merit

The boar's body composition or carcass merit can be evaluated by taking measurements like backfat thickness, loineye area and estimating percent muscle. Of these measurements, backfat is the single most important and the best measure of leanness. These traits have high heritability values and show low heterosis response with crossbreeding. They are medium in overall economic importance. Therefore, place most of the emphasis on the boar's own record when selecting for these traits.

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### Soundness and Conformation-Type

Traits associated with soundness include: underline (spacing, number, and presentation); physical soundness of feet and legs; bone size and strength; genetic abnormalities (hernia and cryptorchidism); and mating ability (tagged penis, short penis, limp penis).

The conformation-type traits include those used in visually evaluating boars such as: body length, depth, height, and skeleton size (those items used in describing ruggedness, frame and body capacity); muscle size and shape; and boar masculinity characteristics and testicular development.

Traits such as length, height, underline have high heritability values and give low heterosis responses. These traits vary in their economic importance. Therefore, select on the boar's own record. The physical soundness traits (structural soundness, bone size, and strength) probably have average heritability values, give average heterosis responses with crossbreeding, and have medium to high economic values. Thus, select a boar on the basis of his own record with some attention to litter-mates and other close relatives. The genetic abnormality and mating ability traits have high economic importance; however, for many of these traits additional research is needed to establish "type of inheritance" and "heritability estimates." With these traits, insist that relatives of selected boars be free of these defects and rely on the breeder's integrity.

**Table 1. Heritability level.**

| Trait | Heritability |
|---|---|
| | percent |
| Birth weight | 10 |
| Number farrowed | 10 |
| Weaning weight | 15 |
| Number weaned | 10 |
| Growth rate | 30 |
| Feed efficiency | 35 |
| Meat tenderness | 30 |
| Meat color | 30 |
| Marbling in loin | 30 |
| Firmness of meat | 30 |
| Backfat thickness | 50 |
| Loin-eye area | 50 |
| Carcass length | 60 |
| % ham, chilled carcass weight | 60 |
| % fat cuts, chilled carcass weight | 60 |
| % lean cuts, chilled carcass weight | 50 |

### Selection Facts to Remember

- Each selected boar and gilt will transmit to each offspring a random, sample-half of their heredity (genes) for each trait.
- Not all traits are expressed in boars, e.g., milk production, mothering ability, and so on, but are expressed in their gilt offspring.
- Differences between herd averages for various traits are not all genetic.
- Environmental factors may mask true genetic differences. The effects of these environmental factors are not transmitted to offspring.
- Genetic improvement from selection depends primarily on level of heritability for traits used in selecting boars and gilts and the superiority of these boars and gilts to their herd average for these traits.
- The superiority in performance of selected boars and gilts to their herd average is called **reach.**
- Greater selection reach is possible with fewer number of animals being selected, fewer traits used in selecting animals, and large differences observed for traits in the animals being selected.
- Selection differential is the average reach or superiority of selected boars and gilts.
- Heritability is defined as the percent of the total variation for a trait that is due to heredity. For example, the heritability for pig birth weight is 10%, whereas carcass length has a heritability of 60%. Thus, 10% of the variation in pig birth weight in your herd is due to heredity and 90% is due to environment, that is, your husbandry and management practices. However, with carcass length only 40% of the variation observed in your herd is due to your management and husbandry practices and 60% is due to heredity (genes) transmitted from parents.
- Heritability is also a measure of the proportion of the **average selection differential** for selected boars and gilts that is passed on (transmitted) to their offspring.
- Predicted genetic change in the offspring from selected boars and gilts is equal to "average selection differential" multiplied by "heritability." Heritability level of various swine traits is presented in Table 1. These values range from less than 20% to more than 50%.
- The average predicted performance for the offspring is equal to "your herd average" plus "predicted genetic change in offspring."
- The hybrid vigor (heterosis) response observed with crossbreeding is proportional to heritability of the trait, with lowly heritable traits (Table 1) showing greater heterosis responses than the more highly heritable traits.
- Traits used in selecting replacement boars and gilts may be correlated genetically. That is, two traits may be controlled by the same genes. Other than the slight antagonism observed between meatiness and sow productivity, and meatiness and mating efficiency, it appears that selection may be made for a desirable combination of economically important traits.
- Greater selection reach is possible with boars than with gilts since in most commercial herds 1 boar is selected for every 15-20 gilts. An example of how heritability level of traits and superiority or reach in boars and gilts determines genetic change through selection in your herd is presented in Table 2.
- Emphasize only traits that will increase herd profit.

**Table 2. Examples of how heritability of traits and superiority of selected animals determines genetic change through selection.*†**

| | Pig birth weight | Backfat probe at 230 lb. |
|---|---|---|
| | (lb.) | (in.) |
| Your herd average | 2.7 | 1.5 |
| Average for gilts selected in your herd | 3.0 | 1.3 |
| Boar seller's herd average | 2.9 | 1.4 |
| Selected boars average | 3.2 | 1.2 |
| Superiority or reach in gilts | (3.0 - 2.7)<br>+0.3 | (1.3 - 1.5)<br>-0.2 |
| Superiority or reach in boars | (3.2 - 2.9)<br>+0.3 | (1.2 - 1.4)<br>-0.2 |
| Total superiority or reach in boars and gilts | (0.30 + 0.30)<br>+0.60 | (-0.2 - 0.20)<br>-0.40 |
| Total selection differential for boars and gilts | 0.60/2<br>+0.30 | -0.40/2<br>-0.20 |
| Heritability of traits | 0.10 | 0.50 |
| Predicted genetic change transmitted to offspring | (0.30) x (0.10)<br>0.03 | (-0.20) x (0.50)<br>-0.10 |
| Average predicted performance in offspring | (2.7 + 0.03)<br>2.73 | (1.5 - 0.10)<br>1.40 |
| Percent change in herd average from selection | 1.11% | 6.67% |

*Traits expressed in both boars and gilts. Examples for traits expressed in only one sex, e.g., milk production and mothering ability, much more complicated to present. However, genetic principles are the same.

†Adjustments must be made for known environmental factors, such as sow age, litter size, and sex for birth weight. Backfat needs to be adjusted to a common sex basis, e.g., barrow basis.

## Considerations When Choosing Boars

Select only boars that will maintain present production levels but at the same time will improve weaknesses in your herd. Thus, select top boars from the herd with the best herd average performance.

**Breed of Boar**—The breed of boar may be dictated by the crossbreeding program used. Today about 85-90% of boars are purchased from purebred breeders and about 10-15% are purchased from commercial breeding organizations. Both can be good sources of replacement boars. Both sources have boars that excel in economically important traits. Keep in mind that offspring performance in crossbreeding programs is more predictable if "breeds" and "crosses" are used in a systematic manner. Insist on individual performance records, regardless of boar source.

Select a boar that will improve the weak points of the herd without sacrificing the strong points. Success depends on use of genetically superior boars.

**Table 3. Economic value of production records.**

| | Daily gain | Feed efficiency | Adjusted backfat |
|---|---|---|---|
| | (lb./day) | (lb. F/G) | (in.) |
| Heritability | 0.3 | 0.4 | 0.5 |
| Economic value/unit change* | $4.00/lb./day | $12.00/lb. F/G | $3.50/in. |
| **Records** | | | |
| Boar A | 2.26 | 2.53 | 0.89 |
| Group average | 2.06 | 2.71 | 1.00 |
| Boar B | 1.86 | 2.89 | 1.11 |
| Superiority (A-B) | +0.4 | -.36 | -.22 |

Value comparison (Boar A vs. Boar B)

| Trait | (Superiority) | x | (Heritability) | x | (Influence) | x | (Economic value) | = | Added value/ 230 lb. hog |
|---|---|---|---|---|---|---|---|---|---|
| Daily gain | .4 | | .3 | | .5 | | $4.00 | | $0.24 |
| Feed efficiency | -.36 | | .4 | | .5 | | 12.00 | | 0.86 |
| Backfat | -.22 | | .5 | | .5 | | 3.50 | | 0.19 |
| | | | | | | | | | $1.29 |

*Economic value/unit change represents average values derived by the National Swine Improvement Federation (NSIF) Index Standardization Subcommittees. These are subject to change over time.

**Age of Boar**—Select and purchase boars at 6-7 months of age for use beginning at a minimum of 8 months of age. Remember, most boars do not reach sexual maturity until about 7 months of age, and many boars are used at too young an age because they appear to be large enough. It is recommended that all replacement boars be purchased at least 60 days before the breeding season starts. This allows them to be isolated and checked for health, conditioned to the farm, and test-mated or evaluated for reproductive performance.

**Production Performance Records**—Performance records of boars or their litter-mates are essential in boar selection. Today more breeders are keeping records on boars through on-farm and central station testing programs. When selecting boars on the basis of performance records, consider, if possible, only those in the top 50% of the herd or test group, only those from litters of 10 or more pigs farrowed and 8 or more weaned, and only those that were raised under production conditions similar to those that exist on your farm—e.g., on concrete or on slats, in confinement or on pastures.

**Pedigree Records of Boars**—Pedigree gives the ancestry of the boar and is most useful when combined with performance records of sex related traits (e.g., milk production, mothering ability) of relatives listed in pedigree. This type of information also helps in determining the boar's potential breeding value for many of the lowly heritable traits.

**Health of Boar**—The health history of the seller's herd and of the potential herd boar is one of the most important factors to consider. Buy boars from a herd that has a good herd health program. Observe all animals in the herd. Obtain information on herd health treatments and nutritional program followed in development of prospective boars. Reputable breeders will give written health management records for the boars.

**Central Test Stations**—The more than 40 central test stations provide an excellent source of superior replacement boars, with the ultimate in test records. The leading breeders consign their best boars to such tests. These tests help in locating the genetically superior boars since all boars are tested under a uniform environment. Since only limited numbers of test station boars are available, producers may look to herds doing well at test stations for replacement boars. On-farm tests in these herds would also locate superior boars.

**Production Records Do Pay**—Daily gain, feed efficiency, and backfat are three major economic traits that can easily be measured on replacement boars, regardless of whether they are tested in a central test station or on a breeder's farm. An example of the economic value of production records of two boars recently tested, from 60 to 230 lb., at a central test station is given in Table 3. The economic advantage of $1.29/pig given for Boar A over Boar B assumes no selection pressure from sows and that both boars could be mated to the same set of gilts. Based on this comparison, if Boar A sires 700 pigs, he would return to the producer an extra $903. Replacement gilts retained in the herd will increase his value even more.

**Suggested Selection Standards for Replacement Boars**—Remember, if possible, select boars from the top 50% of the test group with both station and on-farm sources. However, boars meeting the following standards should receive serious considerations as potential herd sires:

| Trait | Standard |
|---|---|
| Litter size | 10 or more, farrowed, and 8 or more, weaned. |
| Underline | 12 or more, fully developed, well-spaced teats. |
| Feet and legs | Medium to large bone, wide stance both front and rear, free in movement, good cushion to both front and rear feet, equal sized toes. |
| Age at 230 lb. | 155 days or less. |
| Feed/gain, boar basis (60-230 lb.) | 275 lb./cwt. gain or less. |
| Daily gain (60-230 lb.) | 2.00 lb./day or higher. |
| Backfat probe (adj. 230 lb.) | 1.0 in. or less. |



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